TRANSPORTATION DEVICE WITH SELECTIVE ENABLING OF FORE-AFT AUTO-BALANCING

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefit of provisional application No. 62/634,115, filed Feb. 22, 2018, for Selective balancing modes for auto-balancing personal transportation devices by the inventor herein.

FIELD OF THE INVENTION

[0002] The present invention relates to auto-balancing transportation devices and, more specifically, to strategically enabling and disabling auto-balancing in such devices.

BACKGROUND OF THE INVENTION

[0003] The prior art includes several auto-balancing transport devices. These include the Segway, developed by Kamen et al and disclosed in U.S. Pat. No. 6,302,230 (among others) and the Solowheel (U.S. Pat. No. 8,807,250) and Hovertrak (U.S. Pat. No. 8,738,278) by Chen, the inventor herein. These three patents are hereby incorporated by reference as though disclosed in their entirety herein.

[0004] The prior art also includes Iota™. Iota is a central wheel structure auto-balancing device, like the SoloWheel. A central wheel structure infers that the wheel structure is between (or central) to two foot platforms, a rider straddling the wheel structure while riding. The wheel structure can be a single wheel (rim and tire) or a single rim with multiple tires, or multiple rims and tires coupled together, or the like.

[0005] In Iota, the foot platforms are located relatively close to the ground, compared, for example, to SoloWheel and similar devices. Also, since Iota is fairly low in height, i.e., smaller radius wheel, there may be less vertically ascending structure to contact the lower leg of a rider and thereby enhance stability and control (by providing another point of contact).

[0006] Specifically, when mounting Iota, a rider typically places one foot on a foot platform, while the other foot remains on the ground. This tilts the device laterally (to the side). If the ground under the rider is sloped in fore-aft, the foot platform the rider is standing on will likely slope also thereby moving the platform from a neutral pitch angle and causing the auto-balance function to move the device to recover the neutral pitch. Similarly, if the placement of the rider's foot on the platform causes the platform to rock or move out of neutral pitch, the auto-balance function will begin moving the device. Movement of the device in this manner makes mounting, for example, placement of the second foot on its platform difficult.

[0007] A need thus exists to control the enabling of auto-balance based driving when a rider is mounting the device. Needs also exist for better managing the transition from mounting to riding, for detecting and accommodating rider wobble, and for other rider experiences, such as spin, dismounting and related actions.

SUMMARY OF THE INVENTION

[0008] Accordingly, it is an object of the present invention to provide an auto-balancing transportation device that overcomes the shortcomings of the prior art.

[0009] It is another object of the present invention to provide an auto-balancing transportation device that affords a better mounting and/or use experience for a rider.

[0010] It is also an object of the present invention to provide an auto-balancing transportation device that utilizes fore-aft pitch, lateral tilt and/or the presence of a rider's foot or feet to control or influence auto-balance based drive.

[0011] These and related objects of the present invention are achieved by use of a transportation device with selective enabling of fore-aft auto-balancing as described herein.

[0012] The attainment of the foregoing and related advantages and features of the invention should be more readily apparent to those skilled in the art, after review of the following more detailed description of the invention taken together with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIGS. **1-2** are a perspective view and an elevation view, respectively, of an auto-balancing device in accordance with the present invention.

DETAILED DESCRIPTION

[0014] Referring to FIGS. **1-2**, a perspective view (from an above angle) and an elevation view (in a laterally tilted position) of an auto-balancing device **10** in accordance with the present invention are shown, respectively.

[0015] Device **10** preferably includes two foot platforms **20**, **30**, a wheel structure **40**, a motor **50** (interior to the device) that drives wheel structure **40**, a position sensor **50** capable of detecting fore-aft pitch angle and lateral tilt angle, a control circuit **60**, a battery **90**, a housing **92**, a handle **94**, and an on/off switch **96**. The foot platforms preferably fold in when not in use. Device **10** employs auto-balance based control that detects a deviation of the foot platforms from a neutral pitch and drives the wheel structure forward or backward based on the magnitude and direction of the deviation from the neutral pitch. Auto-balancing devices of this type are known in the art and include those mentioned in the Background of the Invention section above, among others.

[0016] Wheel structure **40** is preferably centrally located, side-to-side, and in the embodiment of FIG. **1** has a tire **42** coupled to rim **41**. Tire **42**, in lateral cross-section (top or bottom), may be wider than tall and even 1.5× or 2× or more wider than tall (for example, as shown). While a single wide tire is shown in FIGS. **1-2**, two (or more) tires may be provided in wheel structure **40**, and in combination they may have a similar width to height ratio (hence enhancing lateral stability).

[0017] Position sensor **50** may be a gyroscopic sensor. A gyroscopic sensor can sense fore-aft pitch angle, lateral tilt angle, acceleration and other parameters. A separate fore-aft pitch angle sensor, lateral tilt sensor, accelerometer(s), and the like, may be used without departing from the present invention.

[0018] Control circuit **60** may include a microprocessor or other suitable processing device or arrangement.

[0019] Device **10** may also include foot presence sensors **25**, **35**. These sensors may take several forms, including but not limited to pressure that detect the weight of a rider on a given foot platform, or an electro-magnetic radiation based sensors that detects a foot (or a blockage or reflection of EM radiation) at the foot platforms, or other suitable sensors. In